# KINEMATIC ANALYSIS OF SUCCESSFUL AND UNSUCCESSFUL FREE SHORT OF WHEELCHAIR BASKETBALL PLAYER

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# CHAPTER-1

# INTRODUCTION

Wheelchair basketball emerged in the United States around 1945 as a form of physical rehabilitation therapy for wounded World War II soldiers. Around the same time, at the Spinal rehabilitation Hospital in Stoke Mandeville in Great Britain, Sir Ludwig Guttmann developed a similar sport for people using wheelchairs. The first organised game of wheelchair basketball was played at a hospital in the United States for World War II soldiers Corona Naval Station, California and Framingham, Massachusetts in 1945. A wheelchair-bound British war veteran began playing wheelchair netball independently at Stoke Mandeville Hospital in 1948 under the direction of Dr Ludwig Guttmann (GER). In 1949, the first wheelchair basketball tournament was held in Illinois, USA, with six teams participating. In the same year, the National Wheelchair Basketball Association was founded in the United States.When the Pan Am jets of the United States were asked to play at the international Stoke Mandeville Games in 1955, they brought Wheelchair Basketball to Europe. At first, they had to settle for Wheelchair Netball.After winning the match decisively, wheelchair netball was replaced with basketball in subsequent contests due to their performance.One of the sports at the first Paralympics in Rome in 1960 was wheelchair basketball.

During the mid-1960s, women's wheelchair basketball made its debut when a US team participated in the Paralympic Games in Aviv, Israel, alongside the US men's team. At that time, the National Wheelchair Basketball Association (NWBA) only had a men's division, leaving the few women who played in the US to compete against all-male teams.It was not until 1970 that a women's team, the University of Illinois Ms. Kids, was formed. In the following years, specifically during 1973 and 1974, the Ms. Kids had the opportunity to play alongside the Southern Illinois University Squidettes at the Men's Old Gym on the campus of the University of Illinois in Urbana. This marked a significant step in the development of women's wheelchair basketball, as it provided an avenue for female athletes to showcase their skills and passion for the sport.This was the first documented women's wheelchair basketball game between the two organised teams in the United States, as well as the

first women's basketball game on wheelchair between the two collegiate teams. In 1977, Bob Szyman, a graduate student at the University of Illinois who would later be inducted into the Hall of Fame, suggested that the National Wheelchair Basketball Association start a Women's division. Six teams were formed after the proposal was approved. These six teams played in a national tournament hosted by the University of Illinois in 1978.Since 1991, the National Wheelchair Basketball Association has gained a substantial amount of public recognition. It was admitted as an associate member of Congress. It is now an active member of the United States basketball league. Its previous commissioner, Stan Labanowich, a University of Illinois graduate, and member of the National Wheelchair Basketball Association Hall of Fame, were appointed to USA Basketball's Board of Directors.

Wheelchair basketball has come a long way since its inception in the United States in 1946. The National Wheelchair Basketball Association has grown to over 200 teams since then. Hundreds of teams from North America, South America, Africa, Asia, and Europe have sprung from the novel National Wheelchair Basketball Association.At the Paralympics and World Championships, the United States now competes against teams from these regions.

Sports have involved large numbers of people, both participants and spectators, in almost all nations and civilizations around the world. The world's perception of competitive sports has undergone a dramatic shift in the past few decades. Nowadays, society as a whole is becoming increasingly concerned about the performance of their athletes at the national and international levels, transforming sports competition into a thrilling and challenging endeavour. (Brar, et al., 2010). Sports is an overgrowing aspect of human existence. It has evolved from a very simple beginning into a highly organised activity of human society. A combination of mental preparation,physical ability, training,conditioning, and the capability to perform well under pressure determines an athlete's success or failure.Competitive sports require both a high level of physical ability and a keen mental concentration. In todays world where athletes are becoming increasingly similar physically, technically, and strategically, the mind offers perhaps the greatest competitive advantage (Kathuria and Nanda, 2013). Sport is the root of physical education. As a form of recreation, sport carries with a greater educational value and helps deal with the educational psychology.Sport as a competitive event, places an emphasis on emotions

and behavioural learning. Its dynamics change. Consequently, the subfield of psychology which focuses on performancesport can be called sport psychology (Sahu, 2016). So, sports psychology has advancedswiftly in current years. According to John Luther, sport psychology is a collection of evidences and ideologies pertaining to learning athletic performance and related human behaviour. It is the study of human performance, physical activity, and exercise. Few sports psychologists collaborate with trained athletes and coaches to enhance performanceand increase motivation (Adling, 2017). In the past two decades, sport psychology has developed as a real field of scientific inquiry, and a great deal of research has been conducted on the reasons why an individual's level of performance is rising steadily. The variation in performance between practise and competition is the subject of current research. In spite of having the right technique, the right exercises, the right diet, and the right equipment, it was determined that psychological factor constitutes one of the most important factors in enhancing a player's performance under pressure (Kumar, 2016). Widely acknowledged is the significance of sports psychologists as integral members of coaching and health care teams. Athletes can benefit from the guidance of sport psychologists by honing their motor skills, increasing their awareness to the level necessary for peak performance, and learning to concentrate despite the many outside distractions that come with team travel and competition.An integral part of the training process is a focus on the importance of the individual's psychological make-up. Although this is best accomplished through teamwork between the coach, sport psychologists, and the athlete, any coach with enough motivation and interest can pick up and teach their players some fundamental psychological techniques. Track and field events are primarily individual contests in which competitors compete to determine a single winner.Depending on the specific event, numerous factors may contribute to its success. Training, ability to be trained, physical, composition of the body, dietary needs, technique, awareness of strategy, incentive, and a variety of psychological traits are often just as important as innate talent in most sports. (Maughan, 2009). The improvement of the athlete's mental skills is one of the primary goals of psychological and mental coaching in sport, particularly at the elite level (Raglin, 2001). In addition, sport psychologists have categorised mental skills into three main groups (Bush, Salmela, & Green-Demers, 2000). The fundamental cognitive abilities include goal-setting, self-confidence, and dedication. The

subsequent mental skills will not be effective until the athlete's initial mental skills have stabilised (Bota, 1993; Orlick, 1996). Psychosomatic skills consist of stress reactions, fear management, relaxation, and activation.

## OBJECTIVES OF STUDY

- To determine the pattern of successful and unsuccessful free throws during different phases of basketball based on selected angular and linear kinematic variables.
- Determine the angular and linear kinematic variables responsible for free shot success during different phases.

## DELIMITATIONS

- The research will be limited to male national-level wheelchair basketball players
- This study will be limited to subjects between the ages of 18 and 35.
- Six people who play wheelchair basketball will be the sole subjects of this study.
- All the subject included in the study will have the same upper body height and same playing experiences
- All the subject of the study would right hand, have same arm length and similar shooting action.
- The methodologies of the skill would be analysed at the following three moments: -

**Linear kinematic:**

- COM - centre of mass
- The speed of the ball
- The ball's travel distance.
- The height at which the ball is released.

**Angular kinematics:**

- Angle at the Hip joint
- Angle at the Shoulder joint
- Angle at the Elbow joint
- Angle at the Wrist joint

**Key positions:**

- Preparation phase
- Wind up phase-

The Phase 1

The Phase 2

- Propulsion Phase

The Phase 1

The Phase 2

The Phase 3

## LIMITATIONS

1) The knowledge of previous experience in training will not take into consideration.
2) The diet, healthy habit, style of daily living will be considered as one of the limitations of the study.

## HYPOTHESIS

Based on discussions with subject-matter experts, as well as literature and the researcher's own intuition about the issue at hand. The kinematic modelling will serve as a solid representation.

i) For Wheelchair Basketball, it is hypothesised that different angular Kinematic Variables will reveal differences in the joint movement pattern of successful free throws.

ii) It would be hypothesis that selected linear Kinematic variables will show variation between successful and unsuccessful shorts.

## DEFINITION AND EXPLANATION OF TERMS

## BIOMECHANICS

The field of study known as biomechanics analyses the forces acting on and within the human body, as well as the results of those forces.Biomechanics is the study of how mechanical laws can be applied to the study of biological systems.

## KINEMATICS

The study of motion in terms of the time it takes to execute the action is known as kinematics, and it is a subfield of biomechanics.

### Linear Kinematics

Simply put, linear kinematics studies linear motion without investigating its cause.**Angular kinematics**

Rotation and angular motion are the focus of angular kinematics, although their origins are left unexplored.

## CENTRE OF MASS

The location where all of the body's mass appears to be concentrated. It is the body's centre of gravity. It is a point at which the total torque of the divisional weight equals zero. It is a point at which gravity's force is applied to a mass; it is the centre of gravity.

The centre of gravity is the position at which the body's mass and weight are in equilibrium in all directions.

## BASKETBALL

Basketball is a team sport played on a rectangular court by two teams of five players each, with the primary goal of shooting a basket through the defender's hoop (46 cm in diameter) placed 3.048 m high on the backboard at both ends of the court.The players attempted to stop the opposing team from making a shot through their own basket. Two points are awarded for a field goal unless it is scored from beyond the 3-point line, in which case it is worth three. When a player is called for a foul or is chosen to shoot a technical foul, the time stops, and they are given one, two,

or three free throws, each worth one point. The team with the most points at the end of regulation play wins, but overtime must be played if the score is tied.

**FREE THROW**

A free throw is a shot taken from the foul line without a defender when the other team has made a personal or technical foul. It is worth one point.

**SUCCESSFUL SHOTS**

The one-point attempt from the free-throw line that a player gets when their opponent commits a personal or technical foul.

Is defined as one which passed clearly through the basket without contact with any part of the rim.

**UNSUCCESSFUL SHOTS**

Any successful free throw shot that touched the rim or the backboard, regardless of its success, was claimed to be an unsuccessful shot.

**SIGNIFICANCE OF STUDY**

The significance of this study lies in the following areas:-

- The findings may aid coaches and trainers in developing better methods for training athletes.
- The coaches, players, and exercise scientists who have been calling for more research into this issue will benefit from this study.
- The researcher hopes that by publishing the results of this study, other researchers will be inspired to try to shed further light on the issue.

## CHAPTER-2

## REVIEW OF LITERATURE

The researcher made an effort to find literature connected to this study; the relevant papers discovered from various sources that the researcher came across are listed below.

**Victoria L. Goosey-Tolfrey (2021),** In this study,Goosey-Tolfrey observed the free throw performance of 15 male wheelchair basketball players while capturing their kinematic information in three dimensions. These players were classified by the International Wheelchair Basketball Federation into two groups: Group 1 consisting of 2-2.5-point players and Group 2 consisting of 4-4.5-point players. Both groups displayed similar ball release angles, with both releasing the ball at an angle of approximately 58 degrees. However, we noticed some interesting differences between the two groups in terms of their shooting techniques. Group 2, the 4-4.5-point players, launched the ball from a significantly higher point (mean height of 1.78 - 0.17 meters) compared to Group 1 (mean height of 1.57 - 0.12 meters; $p < 0.05$).While the differences were not statistically significant, Goosey-Tolfrey observed some interesting trends. Group 1 exhibited higher ball release speeds and wrist angular velocity at release, indicating a potential emphasis on these aspects of the shooting motion. On the other hand, Group 2 demonstrated higher shoulder flexion angular velocity at release, suggesting a different emphasis on shoulder movement in achieving successful free throw settings.These findings imply that players in different IWBF classes rely on distinct kinematic tactics to achieve successful free throw performance.

**Shigematsu, Saki; (2021)**, Free-throw accuracy, along with other performance characteristics, was examined in top male wheelchair basketball players. During the study, participants were asked to execute 20 free throws in basketball. The pre-shooting routine was analyzed in terms of the following basketball performance variables: (a) time, (b) minimum angle during ball retrieval, (c) angles at ball release, (d) angle displacement during a forward arm swing, and (e) velocity of angle at ball release on the wrist, shoulder, and hip.The results revealed a statistically significant inverse relationship between the mean pre-shot time and free-throw accuracy, indicating that participants with shorter pre-shot times demonstrated higher free-throw accuracy. Additionally, the study highlighted the importance of consistent hip movement for free-throw accuracy. It was observed that a negative association existed

between free-throw accuracy and the variability of hip angular speed at the time of ball release. Thus, maintaining a steady hip movement seemed to be a crucial factor in achieving accurate free throws.However, neither a player's International Wheelchair Basketball Federation classification point nor their level of wheelchair basketball experience were related to their accuracy on free throws. These numbers seem to indicate a correlation between how often a wheelchair basketball player moves their trunk and how well they shoot free throws.

**Jeffrey J. Martin (2013),** Although it is widely accepted that the success rate of free throw (FT) shooters is lower in wheelchair basketball than in stand-up play, very little is known about the technical aspects of making FTs in either format. Generally speaking, the results of FTs are either a successful attempt or an unsuccessful attempt. However, there is a gradient from a flawless shot to a miss in the real ball pattern at the basket. The goals of this research were to identify the characteristics of FT shooting in a high-level men's wheelchair basketball competition, and pose a way for defining the FT result beyond the standard dichotomous outcome.116 people in wheelchairs had their FT data and game schematics recorded at the sixth Gold Cup World Wheelchair Basketball Championship. The results showed a normal percentage of makes in FT shooting, with the majority of misses coming from short distances. Shot outcome profiles that show specific trends in FT shooting might be efficiently determined and described using the instrument developed for documenting schematic diagrams.

**D. G. Özkan (2019),**People are better prepared to respond to the ever-changing world around them if they can predict and identify shifts in human movement.Modulating the study of domain-specific activities in sports requires expertise, which is essential for fast responding to a new scenario, often before changes in the environment are acknowledged. In this study, the researcherslooked into the neural bases of free-throw prediction in wheelchair basketball players. While being presented with a cinematic stimulus of a free throw, which could result in either a successful or unsuccessful shot, the study conducted electroencephalography (EEG) recordings from two groups: semi-professional wheelchair basketball players with varied ability levels (players) and ambulatory, non-expert individuals (controls). Each participant was tasked with predicting the outcome of the throw on each trial.To

analyze the EEG data, the study calculated the average conditional event-related potential (ERP) for each group. Specifically, we focused on trials where the outcome of the throw could be reliably anticipated. The most crucial kinematic information related to the shot's outcome was found to be in the wrist movement just before the ball release, specifically within the final 100 milliseconds of the shot.mExperts, in particular, exhibited a distinctive pattern in their EEG readings during this critical period. They displayed a larger negative amplitude of the contingent negative variation (CNV) over the Pz electrode, which is considered an empirical indicator of action effect prediction. This observation suggests that skilled players possess a heightened ability to predict the outcome of the free throw based on the wrist movement right before the ball is released.The results in the study provide more proof that competence is linked to a specific pattern of functional modulation in the action observation network.

**Francis, John** (2019), Despite the growing popularity of SPA, its potential use in adaptive sports has received scant study. It's no secret that the men's wheelchair basketball team of Rio de Janeiro, California, is made up of a group of highly trained athletes who are considered among the best in the world. A innovative, legitimate, and dependable SPA template for elite male wheelchair basketball was established after consultation with wheelchair basketball staff. The template was used to analyse 31 games during the 2015 European Wheelchair Basketball Championships and determine the most important aspects in a team's success. The game situation, the defensive system the team in possession is up against, and both offensive and defensive formations were all highlighted as crucial factors in the analysisShot position, location, type, and least defensive pressure all played a role in the success or failure of 1,144 field goal attempts by the top five competing teams at the 2015 European Wheelchair Basketball Championships.

# CHAPTER-3

# METHODOLOGY

## PROCEDURE

The following section will discuss the methods used to identify participants, pick variables, define criteria measurements, collect data, develop a filming routine, analyse footage, and draw conclusions using statistical methods.

## SELECTION OF SUBJECTS

Twenty male national-level wheelchair basketball players in the age range of 18 to 35 will be chosen as participants. Subjects will be briefed about the study's goals and encouraged to give it their all when it comes time to shoot the ball, with the understanding that such proficiency is taken for granted.

## COLLECTION OF DATA

Subjective performance of wheelchair player, as well as the filming protocol and analysis, are detailed below:

## MEASUREMENT OF THE PERFORMANCE OF THE SUBJECTS

The performance of the subject will be the basket converted while taking the trials ,out of five basketball thrown from the free throw line the once converted into basket will be counted as a scores.

## FILMING PROTOCOL AND ANALYSIS

The data will be collected using 2D analysis. The camera analysis software will be **Silicon coach**.First five free throw will be performed by National level wheelchair basketball player. The analysis sequence will be taken under controlled condition. During the shot, the subject will demonstrate proper technique.

## STATISTICAL TECHNIQUE

To analysis the descriptive statistics and t-test will be used. The level of significance will be set at 0.05 for testing the hypothesis.

**SAMPLING PLAN-** Twenty wheelchair basketball players will be selected at random to participate in the study during data collection.

**DESIGN OF STUDY-** All data will be collected and recorded in one sitting, which will take place in the morning on a single day.

## BIBLIOGRAPHY

McGinnis Merton, Biomechanics of Sports and Exercises:U.S.A:Human Kinetic,(2005)

Mller Doris I and nelson Rechard C. Biomechanics and Sports:A research Approach.

London:Philadelphia: Lea and Febiger,1976

Philips D.Allen And Horneck James E. Measurement and Evolution in Physical Education.

New York:john Willey and Sarc Inc.1979

Winter david, Biomechanics and motor control of Human Movement:johnWilleyandsons,Inc,New

Jersey (2005)

Francis, John, "Sports Performance Analysis and the Analyst in Elite Wheelchair Basketball, Sports Performance Analysis and the Analyst in Elite Wheelchair Basketball. PhD thesis, University of Worcester, 2019).